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***January 1993***



***Biology 30***  
***Grade 12 Diploma Examination***

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January 1993

# Biology 30

Grade 12 Diploma Examination

## Description

Time allotted: 2.5 h

Total possible marks: 100

This is a **closed-book** examination consisting of **two** parts:

### Part A

has 70 multiple-choice questions each with a value of one mark.

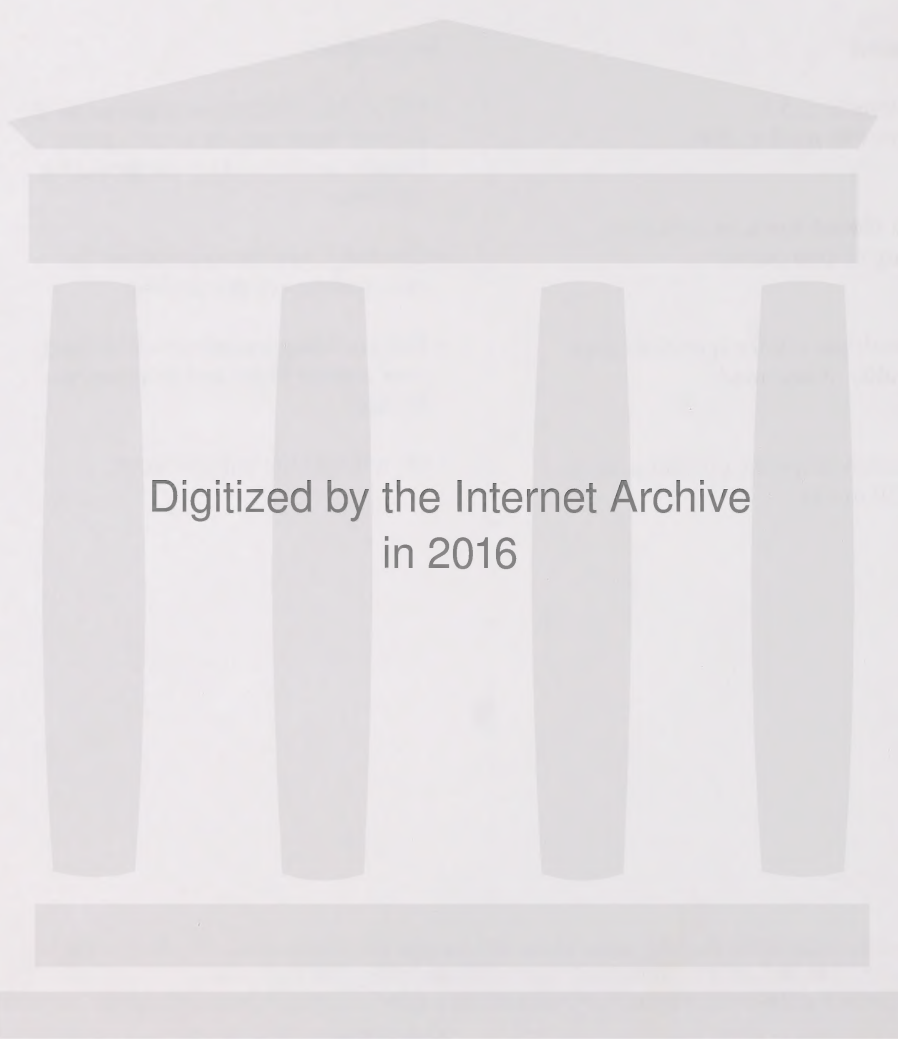
### Part B

has 4 written-response questions for a total of 30 marks.

## Instructions

- Fill in the information required on the answer sheet and the examination booklet as directed by the presiding examiner.
- Carefully read the instructions for each part before proceeding.
- The presiding examiner will collect your answer sheet and examination booklet.
- Do not fold the answer sheet.

**Note:** The perforated pages at the back of this booklet may be torn out and used for your rough work. **No marks** will be given for work done on the tear-out pages.



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# Part A: Multiple Choice

## Instructions

- Read each question carefully and decide which of the choices **best** completes the statement or answers the question.
- Locate that question number on the separate answer sheet provided and fill in the circle that corresponds to your choice.

## Example

This diploma examination is for the subject of

- A . biology
- B . physics
- C . chemistry
- D . mathematics

Answer Sheet

☒ (B) (C) (D)

- Use an HB pencil only.
- If you wish to change an answer, erase all traces of your first answer.

**Note:** The perforated pages at the back of this booklet may be torn out and used for your rough work.

**No marks** will be given for work done on the tear-out pages.

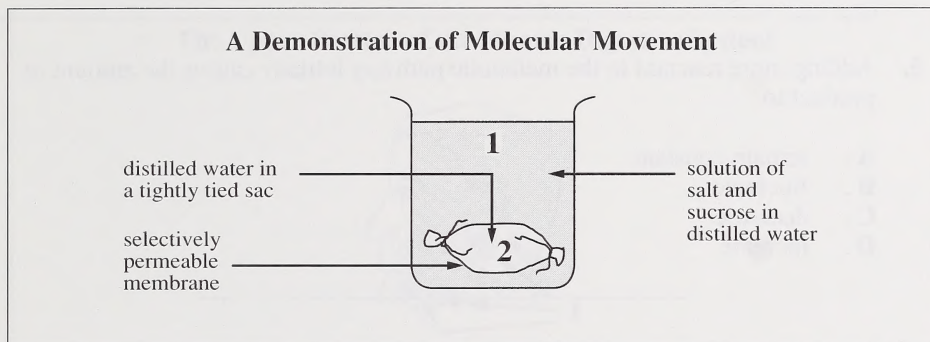
**Do not turn the page to start the examination until told to do so by the presiding examiner.**



1. Water movement across a cell membrane depends upon

- A. lipid layers
- B. active transport
- C. carrier molecules
- D. concentration gradients

*Use the following diagram to answer question 2.*



2. If the selectively permeable membrane is permeable to salt and water but impermeable to sucrose,

- A. salt will move from region 2 to region 1
- B. sucrose will move from region 1 to region 2
- C. net water movement will occur from region 2 to region 1
- D. water movement will occur only from region 2 to region 1

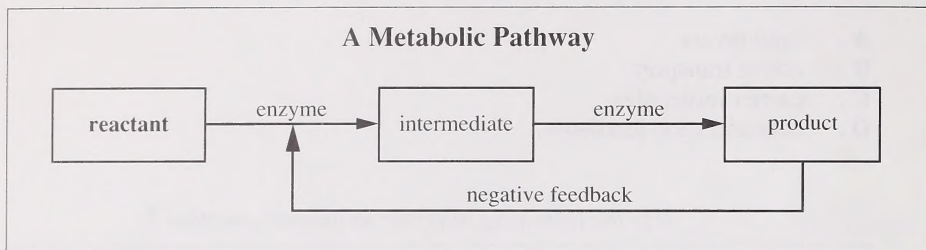
3. For active transport to occur within a cell, what must always be present?

- A. A diffusion gradient
- B. Energy in the form of ATP
- C. An impermeable membrane
- D. A concentration difference between membranes

4. The structural sub-units of enzyme molecules are

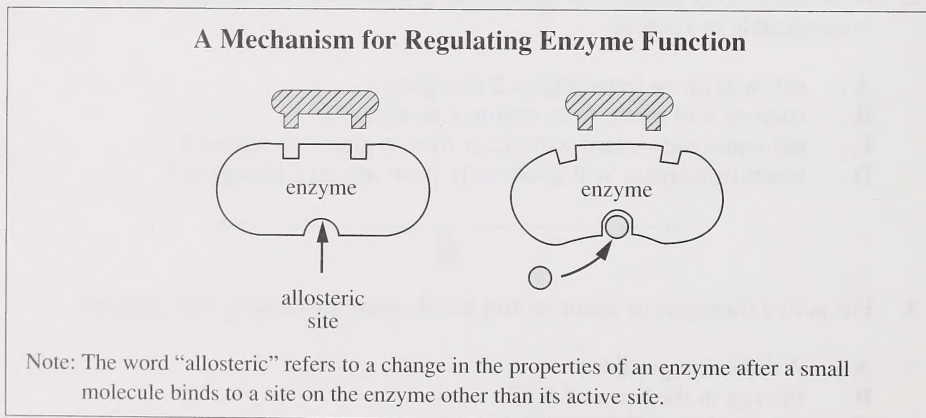
- A. fatty acids
- B. amino acids
- C. nucleic acids
- D. glucose molecules

Use the following diagram to answer question 5.



5. Adding more reactant to the metabolic pathway **initially** causes the amount of product to
- A. remain constant
  - B. fluctuate
  - C. decrease
  - D. increase

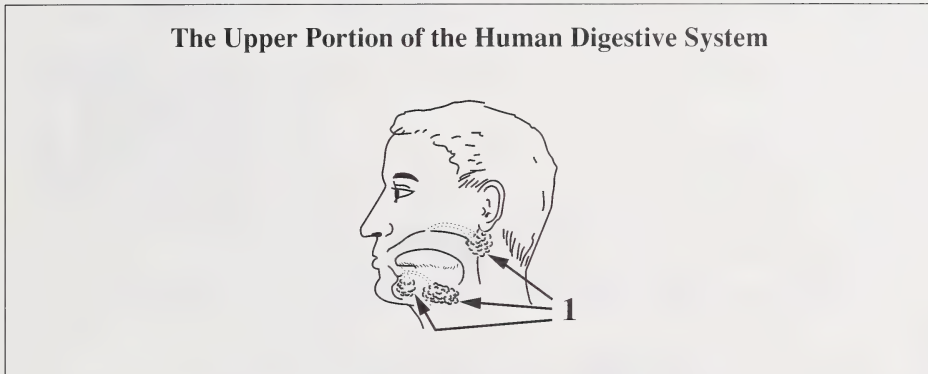
Use the following information to answer question 6.



6. What is the **best** conclusion that can be made from the diagram?
- A. When an inhibitor binds to the allosteric site, the substrate no longer fits the active site.
  - B. When a vitamin binds to the allosteric site, the enzyme no longer fits the active site.
  - C. When an inhibitor binds to the active site, the substrate changes shape.
  - D. When a substrate binds to the active site, the enzyme changes shape.

7. Some materials are eliminated from a cell by
- A. force filtration
  - B. phagocytosis
  - C. exocytosis
  - D. digestion

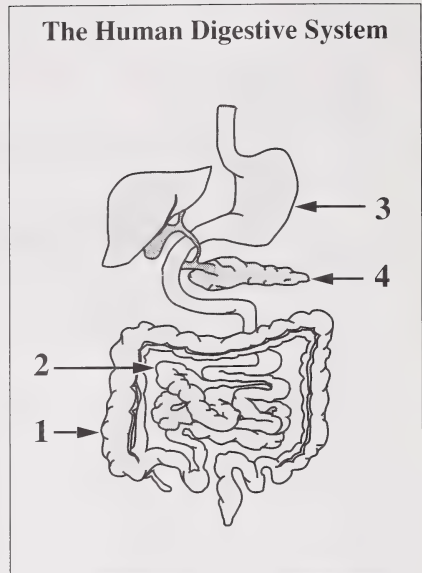
*Use the following diagram to answer question 8.*



8. Structures labelled 1 are important to the process of digestion because they
- A. produce mucus that softens the food and hormones that regulate chemical digestion
  - B. produce juices that moisten the food and initiate chemical digestion of protein
  - C. secrete enzymes that initiate the partial breakdown of proteins
  - D. secrete an enzyme that initiates carbohydrate digestion
- 
9. The wall of the small intestine absorbs food efficiently because it has a large number of
- A. villi
  - B. lysosomes
  - C. Golgi complexes
  - D. digestive enzymes

10. Because alcohol and aspirin are soluble in fat, they are quickly absorbed into the blood after ingestion. Unlike most ingested food, these two substances are absorbed by the structure in the diagram at the right labelled

A. 1  
B. 2  
C. 3  
D. 4

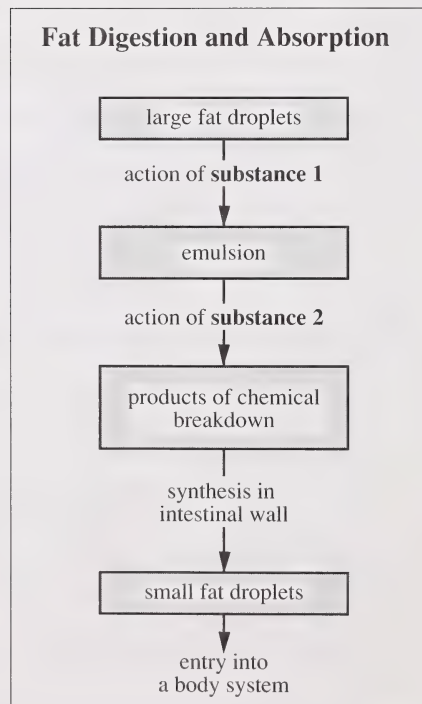


11. Substance 1 shown in the concept map at the right is produced by which organ?

A. Liver  
B. Stomach  
C. Gallbladder  
D. Small intestine

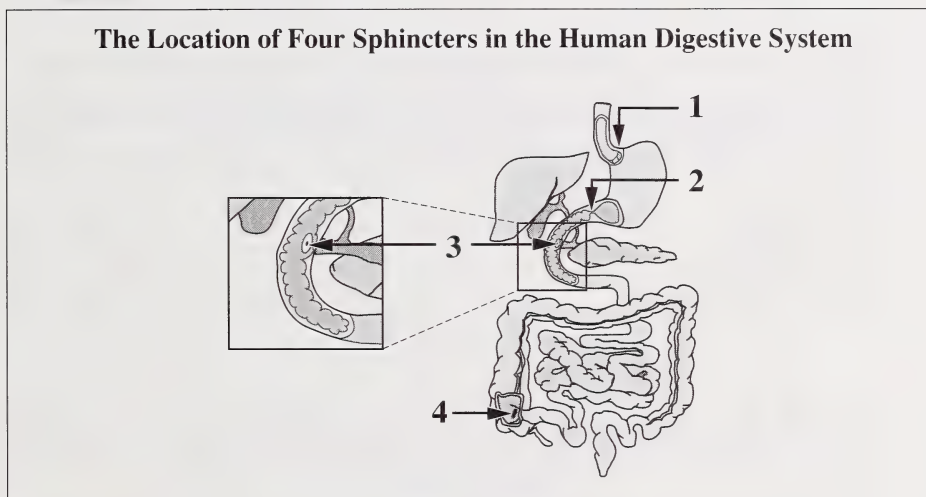
12. Substance 2 shown in the concept map at the right is produced mainly by which organ?

A. Liver  
B. Stomach  
C. Pancreas  
D. Gallbladder



13. A function of the large intestine is to
- complete absorption of the products of chemical digestion
  - complete digestion and absorption of cellulose
  - absorb water, ions, and vitamins
  - absorb enzymes for re-use
14. Pepsinogen is converted to pepsin by
- gastrin
  - nucleic acids
  - hydrochloric acid
  - sodium bicarbonate





*Use the following diagram to answer question 15.*



15. Which row correctly matches a sphincter with the materials that normally pass through it?

Row	Sphincter	Materials that Normally Pass Through Sphincter
A	1	lipase, $\text{H}_2\text{O}$ , bile
B	2	minerals, $\text{H}_2\text{O}$ , undigested plant fibre
C	3	amylase, $\text{HCO}_3^-$ , gastrin
D	4	pepsin, $\text{HCl}$ , secretin

Use the following information to answer question 16.

Possible Procedures to Demonstrate Chemical Digestion of Food				
Test tube	1	2	3	4
Diagram				
Substance	egg white	potato	butter	bread
Enzyme	pepsin	pepsin	amylase	amylase
Incubation	37°C for 24 h	37°C for 24 h	37°C for 24 h	37°C for 24 h
Test applied after 24 h	Biuret reagent	Sudan IV	iodine solution	Benedict's solution and heat

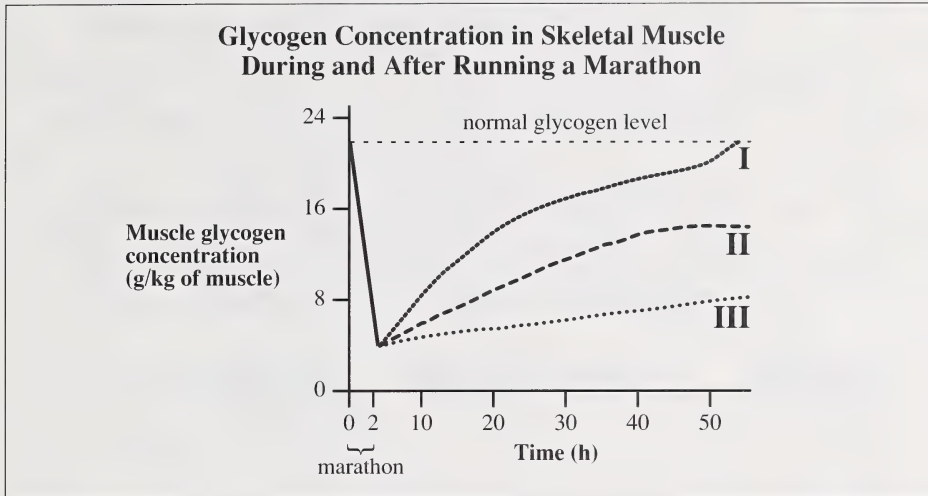
16. Which two test tube procedures would produce results that indicate food was digested chemically?

- A. 1 and 3
- B. 1 and 4
- C. 2 and 3
- D. 2 and 4

17. When people are injured, they may suffer excessive bleeding. One possible cause for this excessive bleeding may be a lower-than-normal number of

- A. both white blood cells and red blood cells
- B. platelets and a decreased blood calcium level
- C. red blood cells and an increased number of platelets
- D. white blood cells and an increased blood calcium level

Use the following graph to answer question 18.



18. A group of athletes participated in an Olympic marathon, a long-distance run that took approximately 2 hours. After the marathon, these athletes ate three different types of food that restored glycogen levels in their muscles at different rates, as shown by curves I, II, and III. Curve I likely represents a diet high in
- A. fats
  - B. proteins
  - C. carbohydrates
  - D. minerals and vitamins

Use the following information to answer question 19.

### Blood Doping

“Blood doping” is a potentially dangerous procedure that involves removing a quantity of blood from the circulatory system of an athlete several weeks before the athlete participates in a strenuous competition. The extracted blood is centrifuged and the concentrated cellular components are refrigerated. During the time leading up to the competition, the blood components in the athlete are naturally restored to normal levels. A short time before the competition, the refrigerated portion of the athlete’s blood is transfused back into the athlete’s circulatory system.

19. An athlete using the blood doping procedure would gain an unfair advantage over other competitors because of an increased
- A. resistance to infectious diseases
  - B. cardiac output and lower blood pressure
  - C. resistance to bleeding in case of an accident
  - D. capacity of the blood to carry oxygen and carbon dioxide

Use the following chart to answer questions 20 and 21.

The Source and Function of Several Blood Components		
Component	Source of Blood Component	Function of Blood Component
1	liver and/or lymphocytes	maintain blood osmotic pressure and pH; active in blood clotting; combat infection
2	material absorbed by intestinal villi	maintain blood osmotic pressure and pH; active in blood clotting; involved in polarization of muscle and nerve cells
3	bone marrow and lymphatic tissue	perform phagocytosis and produce antibodies
4	material absorbed by large intestine	maintain blood volume and transport molecules
5	bone marrow	transport oxygen and some carbon dioxide
6	material absorbed by intestinal villi	provide energy to cells
7	bone marrow	active in blood clotting

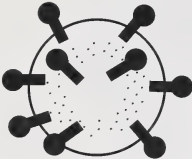
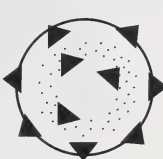
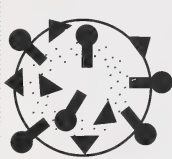
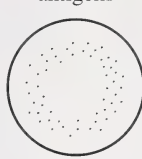



20. Component 6 is most likely

- A. water
- B. oxygen
- C. glucose
- D. vitamins

21. The cellular portion of blood is made up of components

- A. 1, 2, and 3
- B. 2, 4, and 5
- C. 3, 5, and 7
- D. 4, 5, and 7

Use the following chart to answer question 22.

Antigens and Antibodies of Four Blood Groups				
Group	1	2	3	4
Antigens on red blood cells	A antigen 	B antigen 	A and B antigens 	no A or B antigens 
Plasma antibodies			no anti-A or anti-B antibodies	

22. A man has type A blood and a woman has type O blood. The groups in the chart that represent the blood types of the man and the woman **respectively** are

- A. group 1 and group 2
- B. group 1 and group 4
- C. group 2 and group 3
- D. group 2 and group 4

23. An involuntary increase in the rate of breathing results from an increase in

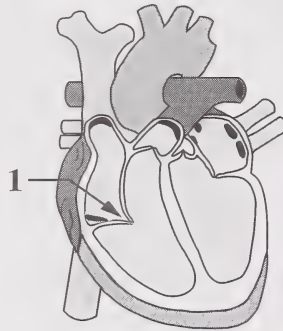
- A. carbon dioxide in the blood
- B. oxyhemoglobin in the blood
- C. the number of nerve impulses from the cerebrum
- D. the number of nerve impulses from the cerebellum

24. One difference between blood and lymph is that **only** blood contains

- A. leukocytes
- B. erythrocytes
- C. inorganic ions
- D. protein antibodies

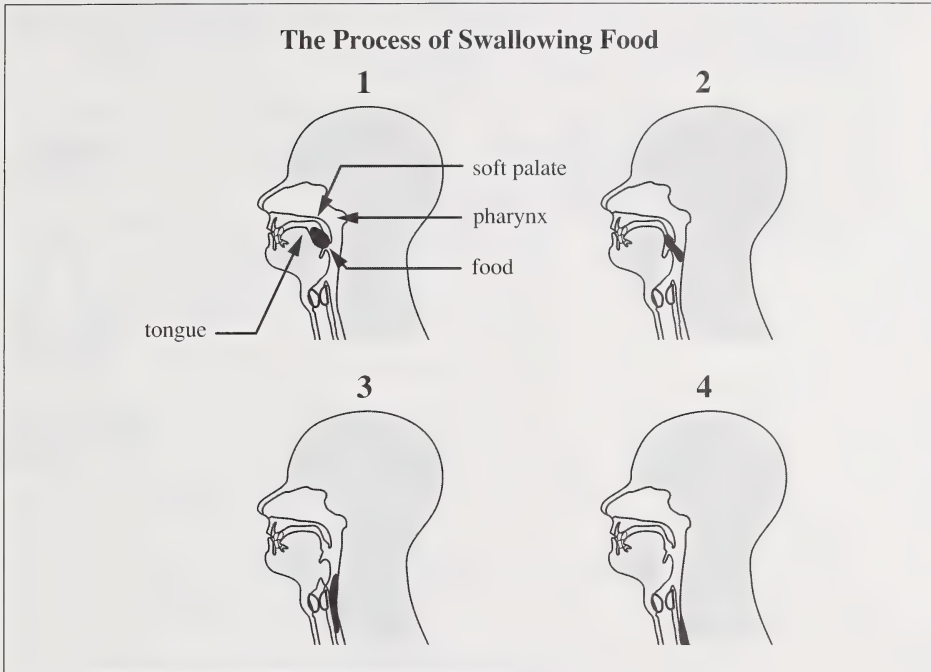
Use the following diagram to answer question 25.

**A Longitudinal Section of a Human Heart**



25. The function of the structure shown at location 1 is to
- A . prevent the backward flow of blood
  - B . receive impulses from the pacemaker
  - C . allow blood to flow from ventricle to atrium
  - D . direct the flow of blood into the pulmonary vein
- 
26. Which component of the respiratory system has the greatest surface area?
- A . Alveoli
  - B . Trachea
  - C . Bronchi
  - D . Bronchioles
27. The correct order of structures through which air moves during **exhalation** is
- A . trachea, bronchus, pharynx, and alveolus
  - B . trachea, bronchiole, bronchus, and alveolus
  - C . alveolus, bronchiole, bronchus, and trachea
  - D . alveolus, bronchus, bronchiole, and pharynx

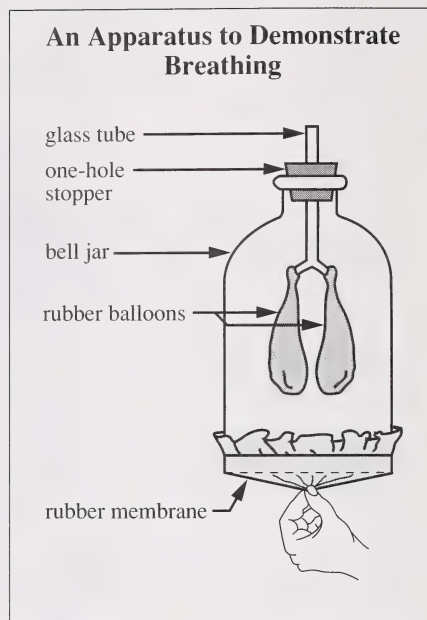
Use the following information to answer question 28.



28. The sequence of events in diagrams 1 through 4 illustrates the function of the
- A. smooth muscles as they move food by peristalsis from the mouth to the pharynx
  - B. epiglottis as it moves downward to prevent food from entering the trachea
  - C. esophagus as it closes to block the entry of food into the trachea
  - D. trachea as it transports food from the pharynx to the esophagus
- 
29. The movement of gases across membranes in the lungs is
- A. a process requiring ATP
  - B. an electrochemical event involving oxygen
  - C. an enzyme-controlled exchange of molecules
  - D. a passive process caused by concentration differences

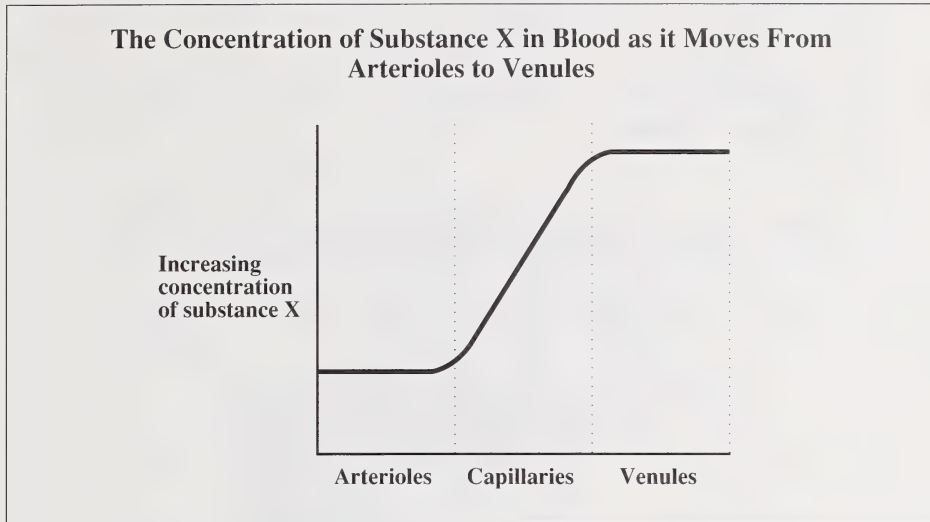
30. The apparatus shown in the diagram at the right could be used to demonstrate that breathing is a result of

A. movement of the ribs  
B. elasticity of lung membranes  
C. diffusion across thin membranes  
D. change in the size of the thoracic cavity



31. Anaerobic respiration occurs in human cells when there is an insufficient supply of
- A. ATP  
B. oxygen  
C. glucose  
D. lactic acid

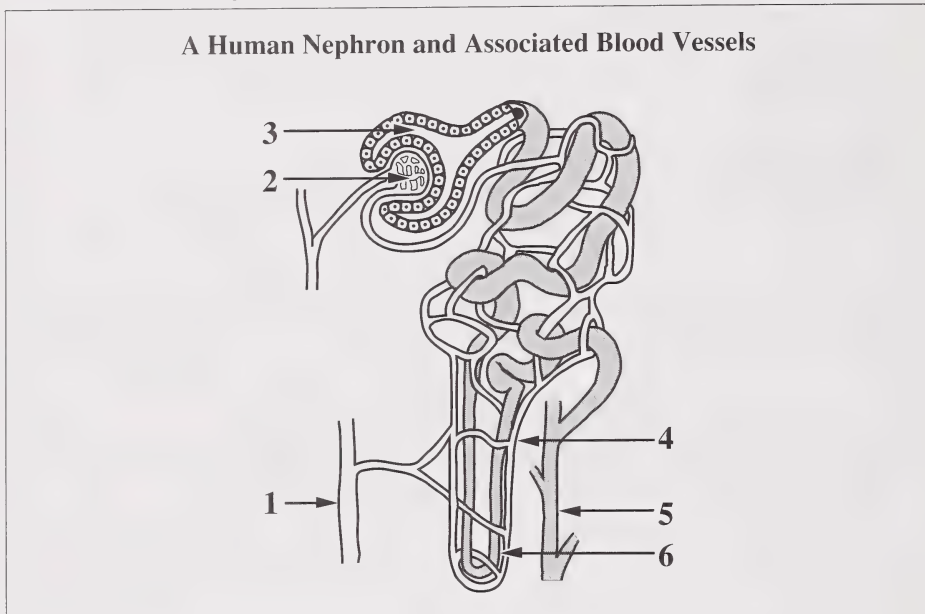
Use the following graph to answer question 32.



32. The concentration of substance X shown in the graph corresponds directly to changing levels of
- A. glucose, as blood passes through active muscles
  - B. carbon dioxide, as blood passes through the lungs
  - C. oxyhemoglobin, as blood passes through the lungs
  - D. oxyhemoglobin, as blood passes through active muscles
- 
33. Two major functions of the kidneys are to
- A. produce urea and maintain ADH levels
  - B. produce urea and maintain water balance
  - C. remove nitrogenous wastes and produce aldosterone
  - D. remove nitrogenous wastes and maintain water balance

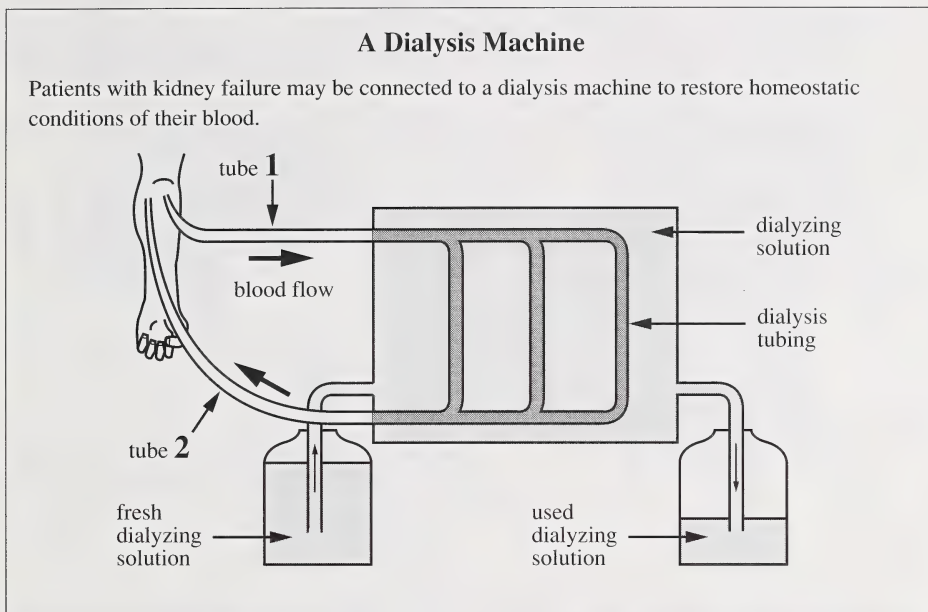
34. In the nephron, plasma proteins do not normally filter through the membranes of the glomerulus because of the proteins'
- A. molecular size
  - B. osmotic pressure
  - C. value to the body
  - D. concentration gradient

*Use the following diagram to answer questions 35 and 36.*



35. Which statement about nephron function is **incorrect**?
- A. Filtered blood returns to the renal vein through the structure labelled 1.
  - B. Water is reabsorbed from the structure labelled 2.
  - C. Material is filtered into the structure labelled 3.
  - D. Urea is carried toward the ureter by the structure labelled 5.
36. The capillaries that receive the greatest portion of reabsorbed sodium ions are labelled
- A. 2
  - B. 3
  - C. 4
  - D. 6

Use the following information to answer questions 37 and 38.



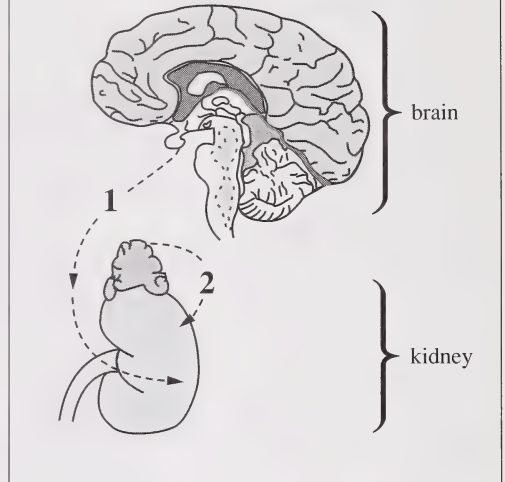
37. As blood moves from tube 1 through the dialysis tubing to tube 2, the concentration of
- A. dissolved salts in the blood will increase
  - B. aldosterone in the blood will increase
  - C. protein in the blood will decrease
  - D. urea in the blood will decrease
38. In one type of dialysis machine, the dialysis tubing consists of thin membranes of cellophane. For effective dialysis to take place in this machine, the
- A. dialyzing solution surrounding the cellophane membranes must contain a lower concentration of wastes than is found in normal blood plasma
  - B. dialyzing solution surrounding the cellophane membranes must contain the same concentration of wastes as is found in normal blood plasma
  - C. fresh dialyzing solution must contain a higher concentration of energy-rich molecules, such as ATP, than is found in normal blood plasma
  - D. fresh dialyzing solution must contain a higher concentration of oxyhemoglobin and glucose than is found in normal blood plasma

Use the diagram on the right to answer questions 39 and 40.

39. The hormones that directly affect the permeability of the tubules of the nephron are represented by labels 1 and 2. These hormones are, respectively,

A. ADH and adrenaline  
B. ADH and aldosterone  
C. thyroxine and adrenaline  
D. aldosterone and adrenaline

**Some Organs and Hormones Involved in Regulating Body Fluids**



40. What effect do the hormones represented by labels 1 and 2 have on the permeability of tubules of the nephron to some substances?

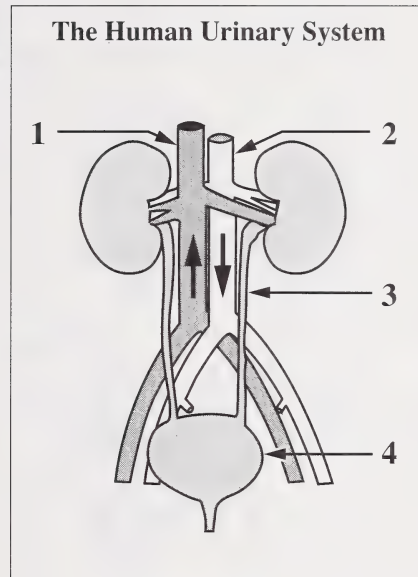
A. Both hormones 1 and 2 increase permeability.  
B. Both hormones 1 and 2 decrease permeability.  
C. Hormone 1 increases permeability and hormone 2 decreases permeability.  
D. Hormone 1 decreases permeability and hormone 2 increases permeability.

41. When a urine sample was tested with Benedict's solution, an orange precipitate formed. A possible explanation for this test result is that the urine contained

A. fats  
B. protein  
C. glucose  
D. glycogen

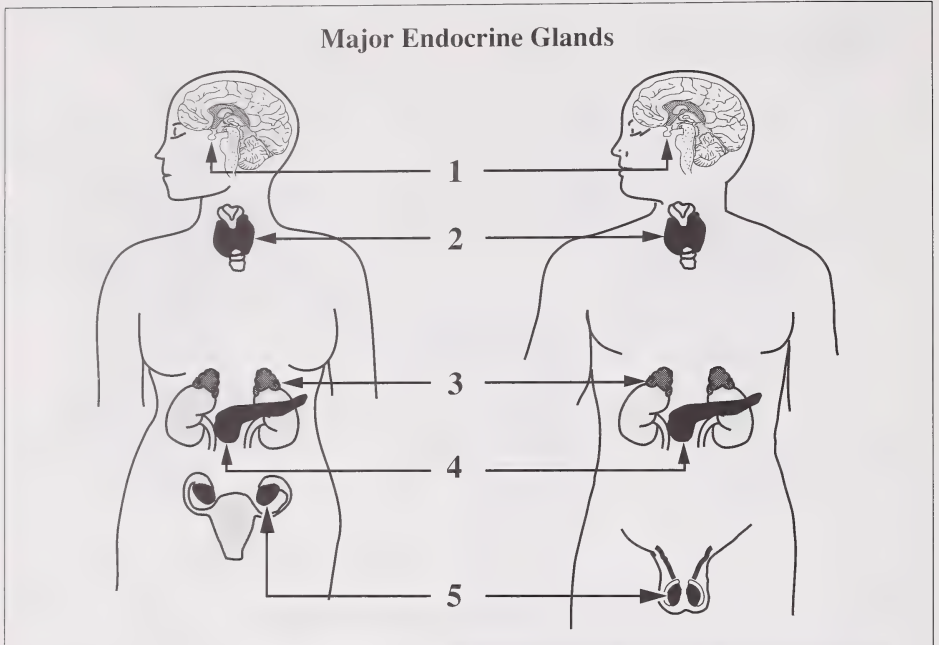
42. The labelled structures in the diagram at the right contain certain fluids. Which statement about the composition of these fluids is **true**?

- A. The plasma in structure 1 carries more glucose than the plasma in structure 2.
- B. The red blood cells in structure 1 carry more oxygen than the red blood cells in structure 2.
- C. The fluid in structure 2 has a higher concentration of urea than the fluid in structure 4.
- D. The fluid in structure 3 has a higher concentration of urea than the fluid in structure 1.



43. Most cells of the human body directly receive a variety of endocrine secretions through the activity of which system?
- A. Digestive system
  - B. Excretory system
  - C. Circulatory system
  - D. Reproductive system
44. The part of an action potential during which a neuron cannot respond to a stimulus is called the
- A. synaptic period
  - B. threshold phase
  - C. refractory period
  - D. depolarization phase
45. When a person suffers an injury to the cerebellum, one effect on the body is the loss of
- A. memory
  - B. co-ordination
  - C. sensory perception
  - D. breathing regulation

Use the following diagram to answer questions 46 and 47.



46. Blood sugar levels are elevated directly by some secretions from which glands?

- A. 1 and 2
- B. 1 and 4
- C. 2 and 3
- D. 3 and 4

47. A higher-than-normal thyroxine level in the blood inhibits secretion of some substances from the gland labelled

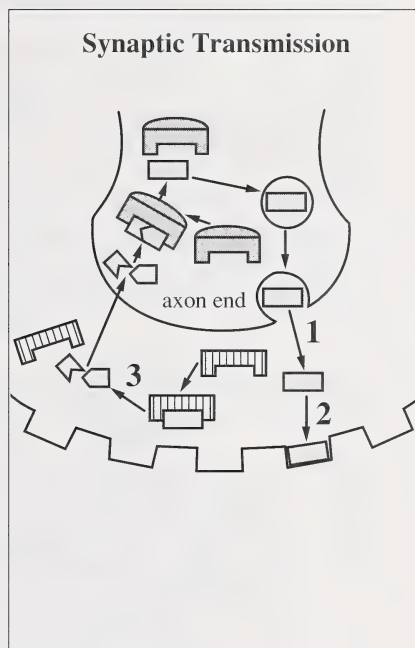
- A. 1
- B. 3
- C. 4
- D. 5

48. The primary function of all neurons is to

- A. interpret stimuli
- B. control responses
- C. transmit impulses
- D. reinforce responses

49. The processes labelled 1 and 2 in the diagram at the right represent

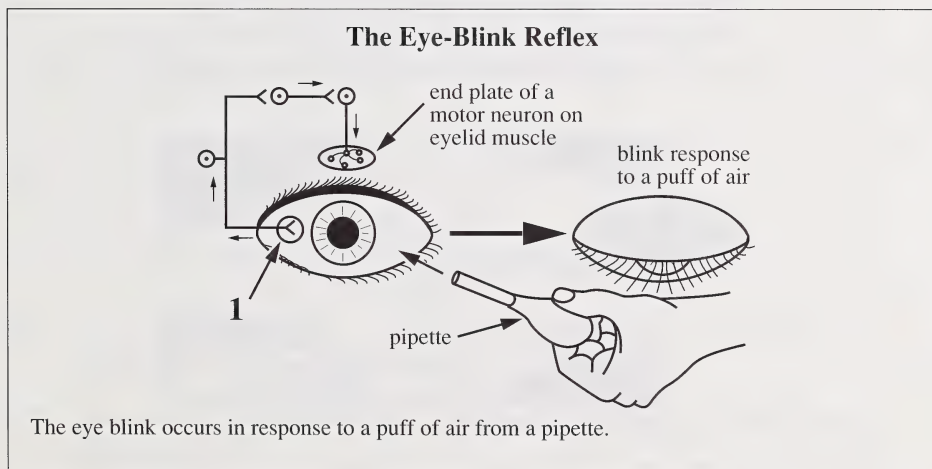
- A. endocytosis and attachment to an axon
- B. exocytosis and attachment to a dendrite
- C. exocytosis and attachment to cholinesterase
- D. endocytosis and attachment to cholinesterase



50. The process labelled 3 in the diagram at the right represents the

- A. synthesis of acetylcholine
- B. synthesis of cholinesterase
- C. breakdown of a receptor molecule
- D. breakdown of the transmitter substance

*Use the following information to answer question 51.*



51. The structure labelled 1 represents part of

- A. a dendrite of a sensory neuron
- B. a dendrite of a motor neuron
- C. an axon of a sensory neuron
- D. an axon of a motor neuron

Use the following information to answer question 52.

### Neurotransmitters of the Autonomic Nervous System

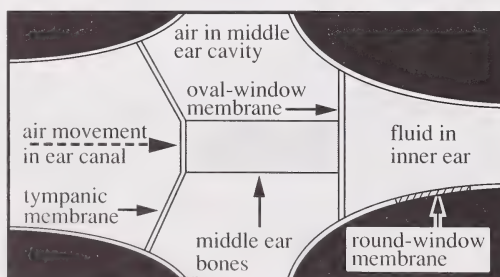
Parasympathetic axons secrete acetylcholine into synapses. Acetylcholine is rapidly decomposed by an enzyme in synapses.

Most sympathetic axons secrete norepinephrine (noradrenaline) into synapses. Most of the norepinephrine released by neurons is reabsorbed into nerve endings by active transport. Norepinephrine reabsorption may take a few seconds, during which time some molecules may enter the blood and remain active until they diffuse into tissues containing decomposing enzymes.

52. Based on this information, which prediction can be made about the different actions of the two regulatory mechanisms?
- A. Acetylcholine produces a more prolonged effect than norepinephrine.
  - B. Norepinephrine produces a more prolonged effect than acetylcholine.
  - C. Parasympathetic fibres transmit impulses faster than sympathetic fibres.
  - D. More energy is required to reabsorb acetylcholine molecules than to reabsorb norepinephrine.

Use the following diagram to answer question 53.

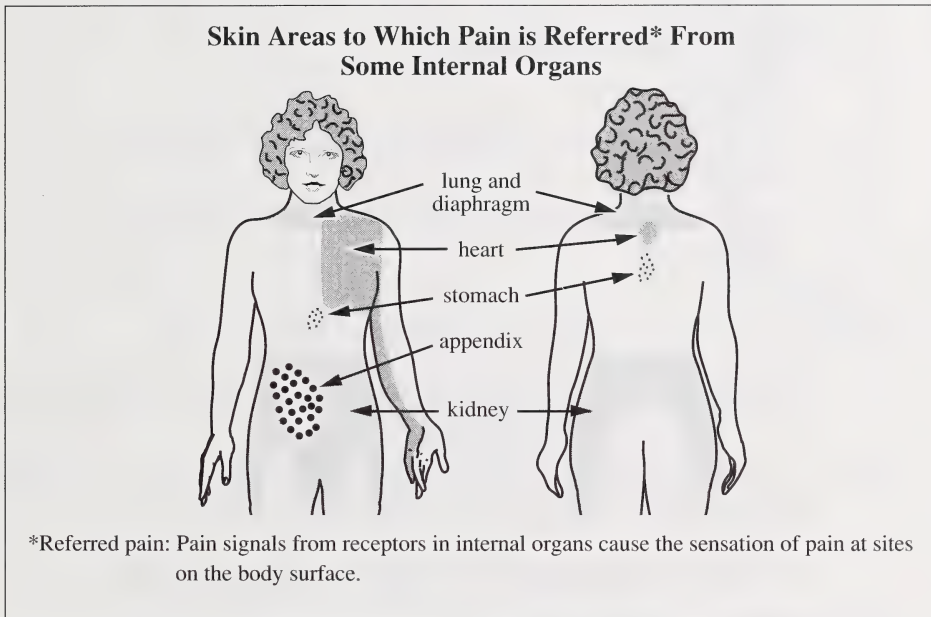
**Diagram Showing How the Middle-Ear Structures Act Like a Piston Against the Fluid of the Inner Ear**



53. When the oval-window membrane is forced inward toward the fluid in the inner ear,
- A. fluid is forced out of the cochlea
  - B. the round-window membrane is forced outward
  - C. fluid is forced toward the bones of the middle ear
  - D. the round-window membrane is also forced inward

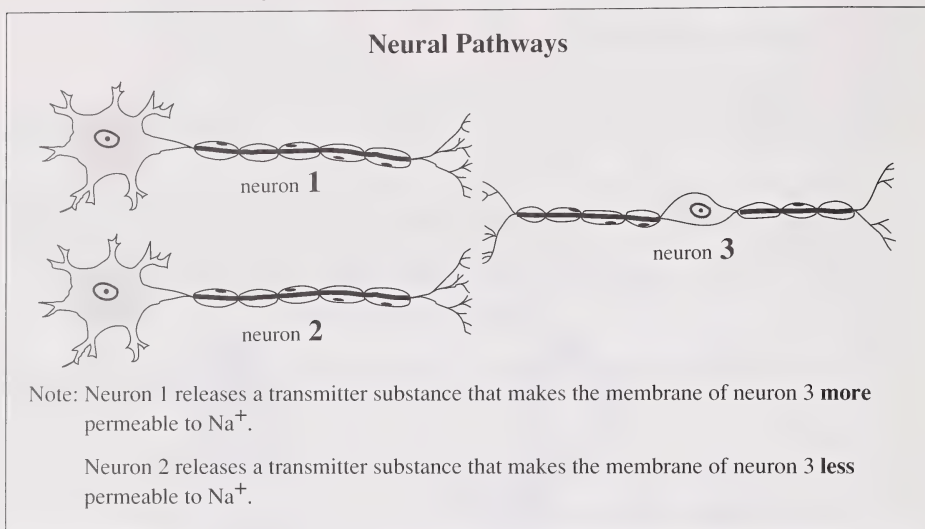
54. The blind spot of the eye is the area of the retina that contains
- A. rods but no cones
  - B. cones but no rods
  - C. both rods and cones
  - D. neither rods nor cones

*Use the following information to answer question 55.*



55. What is an advantage of referred pain?
- A. The overlapping of the skin areas to which pain is referred from different organs allows the person to adapt to internal discomfort.
  - B. A particular body surface region initiates immune responses for fighting infection in the affected internal organ.
  - C. The skin area to which the pain is referred may be treated instead of the affected organ.
  - D. Perceived surface pain could alert the affected person to an internal problem.

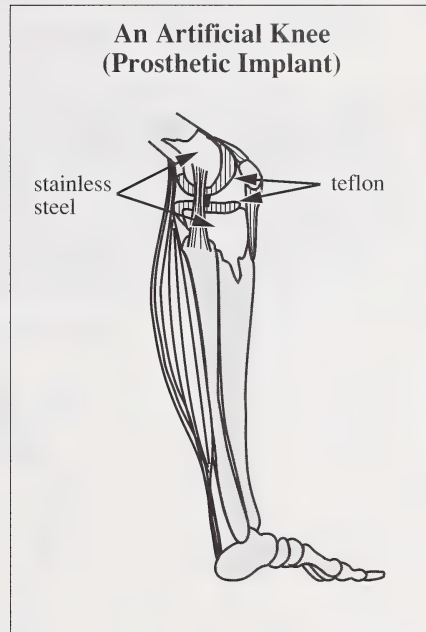
Use the following information to answer question 56.



56. Based on the information given, which inference is likely correct?
- A. Stimulating neurons 1 and 2 simultaneously above their threshold levels will cause neuron 3 to transmit an impulse.
  - B. Stimulating neuron 1 at its threshold level will cause neuron 3 to transmit an impulse.
  - C. Stimulating neuron 1 will raise the threshold level of neuron 3.
  - D. Stimulating neuron 2 will lower the threshold level of neuron 3.
- 
57. Which statement about skeletal muscles is **true**?
- A. Skeletal muscles consist of many individual cells each containing a single nucleus.
  - B. Skeletal muscles contract involuntarily as they perform peristaltic functions.
  - C. Skeletal muscles are under voluntary or conscious control.
  - D. Skeletal muscles are not striated.
58. An inadequate supply of oxygen in muscle tissue results in
- A. the breakdown of glucose
  - B. an accumulation of glucose
  - C. the breakdown of lactic acid
  - D. an accumulation of lactic acid

59. In the artificial knee shown in the diagram at the right, teflon has replaced the function of

A . ligaments  
B . cartilage  
C . tendons  
D . bone



*Use the following information to answer question 60.*

**Events in Muscle Relaxation Listed in Random Order**

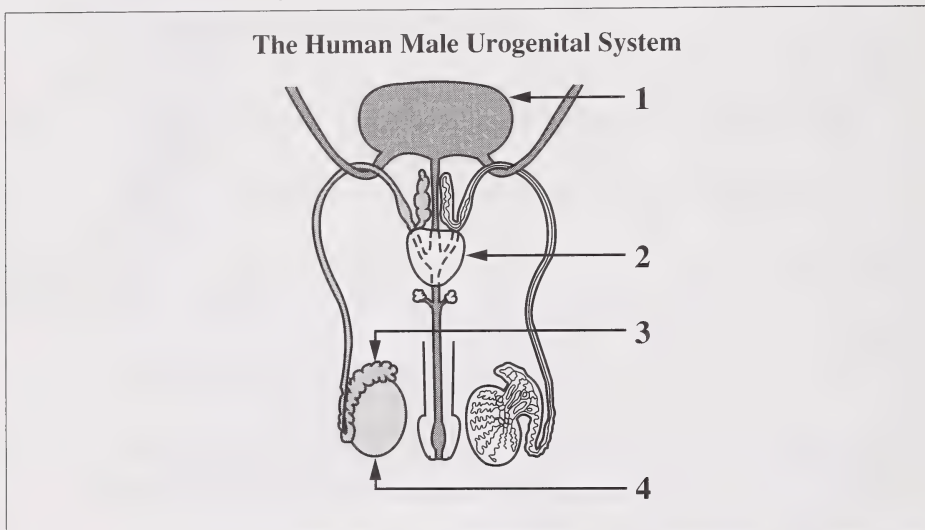
- I. The muscle fibre lengthens as it relaxes, re-establishing its resting state.
- II. Cholinesterase breaks down acetylcholine and the muscle fibre is no longer stimulated.
- III. Actin and myosin filaments slide apart.
- IV. Calcium ions are actively transported into the endoplasmic reticulum of the muscle fibre.

60. The correct sequence of events in muscle relaxation is

A . I, III, IV, and II  
B . II, IV, III, and I  
C . III, I, IV, and II  
D . IV, III, I, and II

61. In human females, the structures involved in egg formation, egg transport, and embryo implantation **respectively** are
- follicle, Fallopian tube, and endometrium
  - Fallopian tube, endometrium, and follicle
  - Fallopian tube, follicle, and endometrium
  - follicle, endometrium, and Fallopian tube

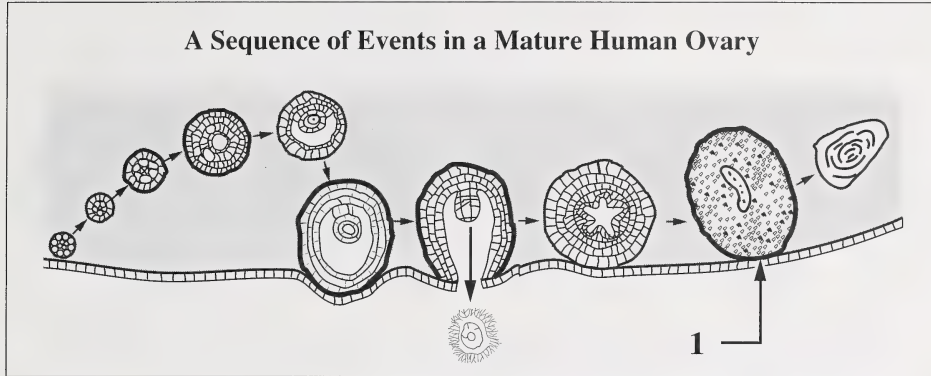
*Use the following diagram to answer question 62.*



62. Which row correctly describes a function of each of the four labelled structures?

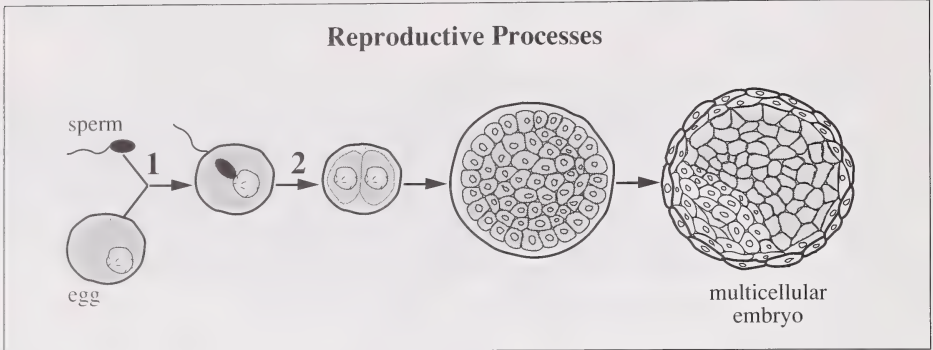
Row	Structure 1	Structure 2	Structure 3	Structure 4
A	stores nitrogenous wastes	controls fluid movement in ureters	stores sugar-rich fluid	produces sperm in response to FSH
B	receives fluid from ureters	adds secretions to semen	stores mature sperm	produces a hormone in response to LH
C	produces urine	produces a sugar-rich fluid	produces sperm	secretes testosterone
D	eliminates urine via the urethra	stores urine	produces sex hormones	stores mature sperm

Use the following diagram to answer question 63.



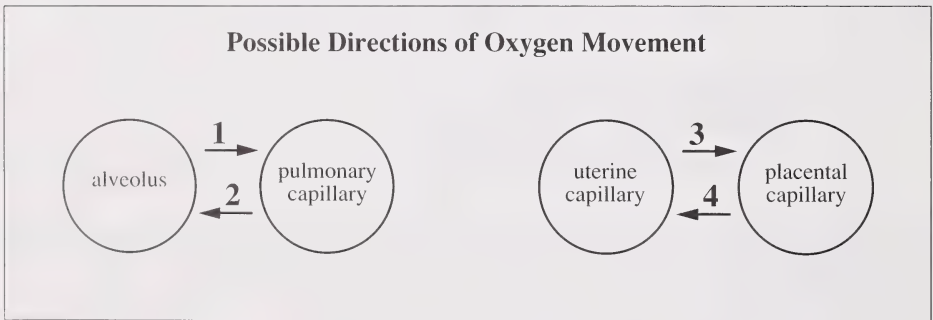
63. The structure labelled 1 produces
- A. the next egg to mature
  - B. progesterone
  - C. FSH
  - D. LH
- 
64. In a human female's menstrual cycle, the uterus does **not** shed its lining if
- A. Fallopian tubes are blocked
  - B. progesterone levels decrease
  - C. progesterone levels are kept high
  - D. the corpus luteum has degenerated
65. A human female is more likely to conceive non-identical twins or triplets if she secretes
- A. limited amounts of FSH
  - B. excessive amounts of FSH
  - C. limited amounts of progesterone
  - D. excessive amounts of progesterone

Use the following diagram to answer question 66.



66. Where do processes labelled 1 and 2 normally occur?
- A. Process 1 occurs in an ovary and process 2 occurs in a Fallopian tube.
  - B. Process 1 occurs in a Fallopian tube and process 2 occurs in an ovary.
  - C. Processes 1 and 2 occur in a Fallopian tube.
  - D. Processes 1 and 2 occur in the uterus.

Use the following diagram to answer question 67.



67. The net movement of oxygen is represented by arrows
- A. 1 and 3
  - B. 1 and 4
  - C. 2 and 3
  - D. 2 and 4

68. In a human female, the hormone oxytocin causes increased

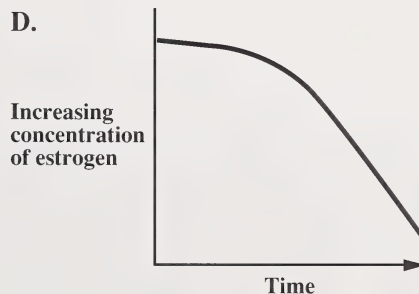
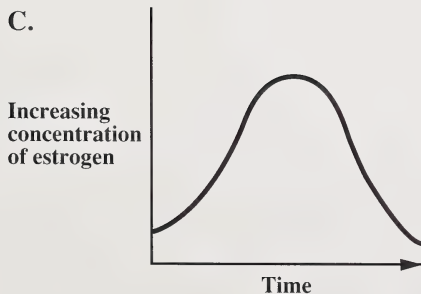
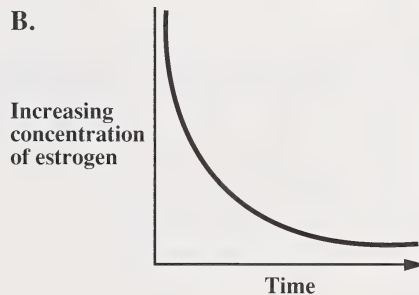
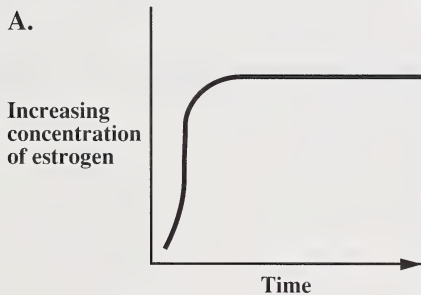
- A. absorption of sugar by the placenta
- B. secretion of progesterone by the ovaries
- C. contraction of smooth muscles in the uterus
- D. secretion of human chorionic gonadotropin by the embryo

*Use the following information to answer question 69.*

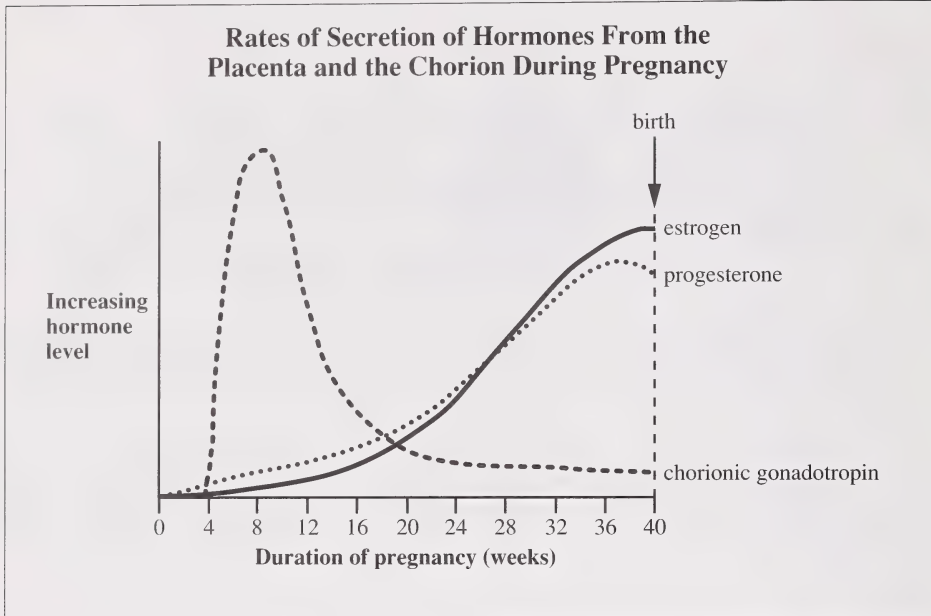
**The Loss of Pituitary Regulation of Estrogen In the Blood**

The pituitary normally responds to high concentrations of estrogen in the blood by reducing its production of FSH. Assume that, immediately following menstruation, the pituitary loses its ability to monitor concentrations of estrogen in the blood but continues to secrete FSH.

69. Based on this information, which graph best illustrates concentrations of estrogen in the blood during the two-week period after the pituitary stops monitoring estrogen levels?



Use the following graph to answer question 70.



70. According to the graph, the placenta is least active and the chorion is most active in maintaining pregnancy during the time period from
- A. week 4 to week 12
  - B. week 12 to week 20
  - C. week 20 to week 28
  - D. week 28 to week 32

*You have now completed Part A. Proceed directly to Part B.*

## ***Part B: Written Response***

### ***Instructions***

- Read each question carefully.
- Write your answers in the examination booklet as neatly as possible.
- Communicate your answers in clear, complete sentences unless the response format dictates otherwise. Marks will be awarded for pertinent explanations and answers. Question 1 has two marks allotted for your written communication.

***Note:*** The perforated pages at the back of this booklet may be torn out and used for your rough work. ***No marks*** will be given for work done on the tear-out pages.

***Start Part B immediately.***

*Use the following information to answer question 1.*

### **Theories of Blood Movement**

Galen, a Greek physician (A.D. 130–200) once said, “If anyone wishes to observe the works of nature, he should put his trust not in books but in his own eyes.”

Until about A.D. 1300, physicians were prohibited by law or religion from dissecting human bodies. The common theory used then to explain the functioning of the circulatory system was the “tidal theory.” This theory stated that blood moved outward from the heart, reversed flow, and returned to the heart while remaining in the same blood vessels.

After A.D. 1300, physicians dissected unpreserved bodies more frequently. By 1628, William Harvey proposed that blood “circulated.” He observed the structure and function of arteries, veins, and the heart but was unable to explain how blood completed the “circle” or pathway that returned it to the heart.

Since Harvey’s time, scientists have collected additional evidence that supports the theory of blood circulation.

**10 marks**

1. Describe the important structures and functions of the circulatory system that complete and promote the “circular” flow of blood. Identify and describe some discoveries in science and technology and/or some laboratory demonstrations that have enabled scientists to accept the theory of blood circulation.

**Note:** **Five** marks will be awarded for your descriptions of structures and functions that promote the “circular” flow of blood. You may use diagrams to enhance your descriptions.

**Three** marks will be awarded for your descriptions of discoveries in science and technology and/or of laboratory demonstrations related to circulation.

**Two** marks will be awarded for the clarity and logical organization of your written communication.

*Continued*

*Continued*

*For  
Department  
Use Only*

CONC

TECH

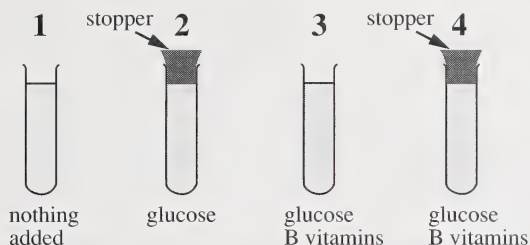
COMM



Use the following information to answer question 2.

### A Laboratory Investigation of Human Muscle Metabolism

Four test tubes containing cultures of live muscle tissue and Ringer's solution\* were prepared. The materials shown were added to three of the test tubes. The contents were maintained at body temperature (37°C) for one hour.



\*Note: Ringer's solution has the same solute concentration and osmotic pressure as the ECF that surrounds muscle tissue.

2. Which culture would produce the greatest amount of ATP? Explain why. Give reasons why the culture you selected would produce more ATP than each of the other three cultures.

**4 marks**



*Use the following information to answer question 3.*

Some Physiological Effects Caused by Autonomic Nervous System Stimulation						
Subject	Adrenal Glands	Thyroid Gland	Peristalsis of Digestive Tract	Pupils of the Eyes	Bronchioles	Heart Rate (beats/min)
1	–	–	+	–	–	70
2	+	+	+	+	+	90
3	+	+	–	–	–	95
4	–	+	–	–	–	75
+ indicates relatively active – indicates relatively inactive				+ indicates dilated – indicates constricted		

6 marks

3. a. Based on your knowledge of the effects of the autonomic nervous system, which of the above subjects appears to be the most relaxed?

Subject:

- b. Support your choice by explaining how the activity level indicated in **five** of the six columns in the chart suggests a relaxed state.

*Continued*



Total: 10 marks

Use the following summary of a research project to answer question 4.

The free walls of the left and right ventricles\* of young pig hearts thicken at a different rate. Researchers wanted to know why.

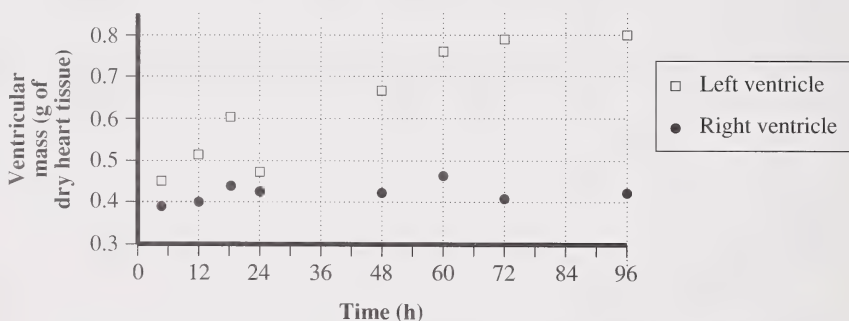
In 1990, at Pennsylvania State University, researchers examined the heart tissue of 152 pigs. Their examinations revealed a greater mass of tissue and RNA (ribonucleic acid) in the left ventricle than in the right ventricle. The researchers hypothesized that this was due to faster ribosome formation in the left ventricle.

To test this hypothesis, researchers designed a procedure to determine the relationship between rates of ribosome formation and the mass of the ventricles at different times soon after birth.

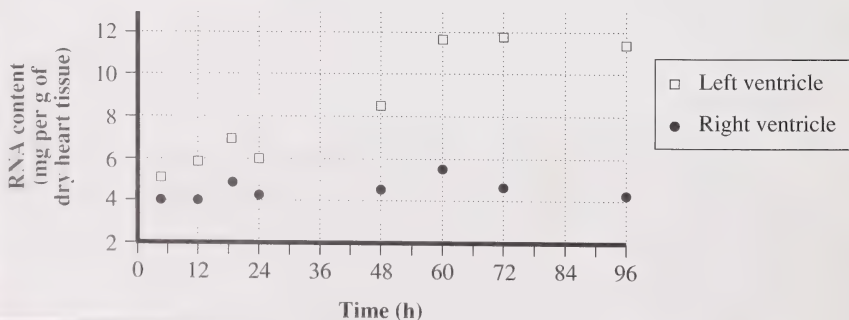
The rate of ribosome formation was determined by measuring the amount of RNA present in the ventricles. Since approximately 85% of RNA is ribosomal RNA, which is used to construct ribosomes, RNA content is proportional to ribosome content.

The rate of ventricular growth was determined by measuring the mass of tissue present in each heart ventricle. **Graphs 1 and 2** show the average results of a series of measurements.

**Graph 1: Mass of Heart Ventricles**



**Graph 2: RNA Content of Heart Ventricles**



\*In their comparison of the free walls of the ventricles, the researchers did not include the septum, the wall separating the ventricles.

Continued

4. a. What specific relationship were the researchers attempting to determine?

(1 mark)

- b. Using the line of best fit for each set of data on **graph 1** and **graph 2**, determine the initial difference (at birth) in the mass of tissue in the right ventricle and the left ventricle, and the initial difference in RNA content in the right ventricle and the left ventricle.

(2 marks)

- c. Comparing the data in **graphs 1** and **2**, what generalization could be made to account for the difference in growth rates in the right ventricle and the left ventricle?

(1 mark)

*Continued*

(1 mark)

- d. Some of the recorded points on **graphs 1 and 2** were obtained by averaging heart tissue measurements taken from as few as two young pig hearts.

Using **graph 1**, examine the plotted point representing left ventricle mass at 24 h. Explain how and why the position of this point on the graph might change if data from a larger number of pig hearts were used.

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(1 mark)

- e. What ribosome function would contribute to the increase in the mass of tissue found in ventricular walls?

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(2 marks)

- f. The researchers fed the pigs soluble organic nutrients that could readily be absorbed by body tissues. Identify one specific organic nutrient (food) that the researchers must have provided to ensure the proper development of heart tissue. Explain the importance of this nutrient.

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*Continued*

**(1 mark)**

- g. Before birth, the right and left side of a pig's heart are connected by two openings. At birth, these openings close and the ventricles begin to develop differences in the thickness of their walls. Suggest one internal stimulus that might initiate responses in heart tissue that cause the left ventricle to develop a thicker wall than the right ventricle.

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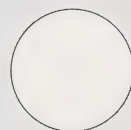
- h. Suggest one reason why the researchers chose to use very young pigs as the subjects of their investigations.

**(1 mark)**

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*You have now completed the examination.  
If you have time, you may wish to check your answers.*



*No marks will be given for work done on this page.*



*No marks will be given for work done on this page.*



*No marks will be given for work done on this page.*



*No marks will be given for work done on this page.*



BIOLOGY 30 DIPLOMA EXAM MULTIPLE-CHOICE KEY

- |       |       |
|-------|-------|
| 1. D  | 36. C |
| 2. C  | 37. D |
| 3. B  | 38. A |
| 4. B  | 39. B |
| 5. D  | 40. A |
| 6. A  | 41. C |
| 7. C  | 42. D |
| 8. D. | 43. C |
| 9. A  | 44. C |
| 10. C | 45. B |
| 11. A | 46. D |
| 12. C | 47. A |
| 13. C | 48. C |
| 14. C | 49. B |
| 15. B | 50. D |
| 16. B | 51. A |
| 17. B | 52. B |
| 18. C | 53. B |
| 19. D | 54. D |
| 20. C | 55. D |
| 21. C | 56. B |
| 22. B | 57. C |
| 23. A | 58. D |
| 24. B | 59. B |
| 25. A | 60. B |
| 26. A | 61. A |
| 27. C | 62. B |
| 28. B | 63. B |
| 29. D | 64. C |
| 30. D | 65. B |
| 31. B | 66. C |
| 32. C | 67. A |
| 33. D | 68. C |
| 34. A | 69. A |
| 35. B | 70. A |

BIOLOGY 30 JAN 93  
 ITEM # 234352-07H12 FR.  
 ITEM # 234237-07J61 ENG.



**SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS**

*Use the following information to answer question 1.*

**Theories of Blood Movement**

Galen, a Greek physician (A.D. 130–200) once said, “If anyone wishes to observe the works of nature, he should put his trust not in books but in his own eyes.”

Until about A.D. 1300, physicians were prohibited by law or religion from dissecting human bodies. The common theory used then to explain the functioning of the circulatory system was the “tidal theory.” This theory stated that blood moved outward from the heart, reversed flow, and returned to the heart while remaining in the same blood vessels.

After A.D. 1300, physicians dissected unpreserved bodies more frequently. By 1628, William Harvey proposed that blood “circulated.” He observed the structure and function of arteries, veins, and the heart but was unable to explain how blood completed the “circle” or pathway that returned it to the heart.

Since Harvey’s time, scientists have collected additional evidence that supports the theory of blood circulation.

- 0 marks)
1. Describe the important structures and functions of the circulatory system that complete and promote the “circular” flow of blood. Identify and describe some discoveries in science and technology and/or some laboratory demonstrations that have enabled scientists to accept the theory of blood circulation.

**Note:** Five marks will be awarded for your descriptions of structures and functions that promote the “circular” flow of blood. You may use diagrams to enhance your descriptions.

**Three marks** will be awarded for your descriptions of discoveries in science and technology and/or of laboratory demonstrations related to circulation.

**Two marks** will be awarded for the clarity and logical organization of your written communication.

*Continued*



## SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS

The student's response **should** include a discussion of some of the following:

### CONCEPTS:

- Capillaries link arteries to veins.
- Veins have valves.
- The heart has valves and the heart chambers are designed to pump blood in a specific direction.
- Arteries carry blood away from the heart.
- Veins carry blood toward the heart.

### SCIENCE AND TECHNOLOGY:

- Microscopes that allow us to view capillaries have been improved.
- Blood pressure cuffs can be used to demonstrate the presence of valves in veins.
- Improved dissection techniques allow us to view most of the structures of the circulatory system.

The student's response **could** include a discussion of the following:

### CONCEPTS:

- Precapillary sphincters control the flow of blood into capillaries.
- Skeletal muscle contraction helps to move blood back toward the heart.
- Blood pressure or gas content varies in different types of blood vessels.

### SCIENCE AND TECHNOLOGY:

- Latex rubber can be injected into dissection specimens to improve the viewing of arteries and veins.
- "Tracers" can be injected into the bloodstream to follow the pathway of blood flow.
- X-rays and CAT scans can be used to view blood vessels in living organisms.
- Attitudes and laws have changed, allowing researchers to investigate the circulatory system further.
- Blood tests indicate varying blood compositions in different types of vessels.



**SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS**

**1. Biological Concepts Component (5 marks)**

SCORE	SCORING DESCRIPTIONS
(5) EXCELLENT	The response consistently identifies the main concepts and demonstrates a clear understanding of circulation by presenting comprehensive, relevant, and accurate structure/function relationships. The response consistently provides concepts that directly and logically support the theory of circulation.
(4) PROFICIENT	The response frequently identifies the main concepts and demonstrates a clear understanding of circulation by presenting comprehensive, relevant, and accurate structure/function relationships. The response frequently points out concepts that directly and logically support the theory of circulation.
(3) SATISFACTORY	The response identifies some of the main concepts and demonstrates an understanding of circulation by presenting relevant and accurate structure/function relationships. The response provides concepts that support the theory of circulation with only minor inconsistencies or omissions.
(2) LIMITED	The response identifies some of the main concepts by presenting structure/function relationships that contain inaccurate or inappropriate information. The response is primarily descriptive with some inaccurate attempts to support the theory of circulation.
(1) POOR	The response contains major errors or omissions with inaccurate structure/function relationships. The response is descriptive without any connection made between concepts and support for the theory of circulation.
(0) INSUFFICIENT	INSUFFICIENT is a special category; it is not an indicator of quality. It should be assigned to papers that do not contain a discernible attempt to address the issue presented in the assignment or are too brief to assess, using this or any other scoring category.

*Continued*



**SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS****2. Science and Technology Component (3 marks)**

SCORE	SCORING DESCRIPTIONS
(3) EXCELLENT	The response clearly describes technology that would allow biologists to support the theory of circulation. The response demonstrates an understanding of both the utility and the limitations of the technology.
(2) SATISFACTORY	The response correctly describes a technology but little attempt is made to describe the utility and the limitations of the technology in supporting the theory of circulation.
(1) POOR	The response ambiguously describes a technology and shows little understanding of the utility or limitations of the technology in supporting the theory of circulation.
(0) UNACCEPTABLE	The response demonstrates an incorrect understanding of a technology or no understanding of the topic is indicated.

**3. Written Communication Component (2 marks)**

SCORE	SCORING DESCRIPTIONS
(2) EXCELLENT	The response communicates the concepts clearly and logically, demonstrating internal consistency of thought. Linkages between cause-and-effect relationships are shown and clearly expressed. Complete sentences that make effective use of scientific vocabulary are used. If applicable, suitable diagrams/sketches are used to illustrate the verbal descriptions. The response addresses the major points of the question.
(1) SATISFACTORY	The response may require more than one reading to abstract the sense. Linkages between cause-and-effect relationships are shown. Some internal inconsistency of thought is evident. Some scientific vocabulary is used. The response addresses some of the major points of the question.
(0) UNACCEPTABLE	The response shows little evidence of internal consistency of thought. The communication is muddled because of inappropriate vocabulary and incomplete sentence structure. The length of the response is inadequate to address even one of the major points of the question.

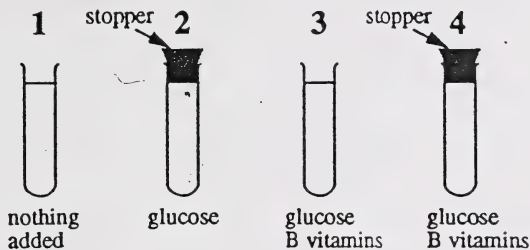


# SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS

Use the following information to answer question 2.

## A Laboratory Investigation of Human Muscle Metabolism

Four test tubes containing cultures of live muscle tissue and Ringer's solution\* were prepared. The materials shown were added to three of the test tubes. The contents were maintained at body temperature (37°C) for one hour.



\*Note: Ringer's solution has the same solute concentration and osmotic pressure as the ECF that surrounds muscle tissue.

2. Which culture would produce the greatest amount of ATP? Explain why. Give reasons why the culture you selected would produce more ATP than each of the other three cultures.

(4 marks)

**1 mark** - Test tube 3 would produce the most ATP because conditions within this tube are optimal for aerobic respiration.

*Award 1 mark for each of the following:*

Test tube 3 would produce more ATP than test tube 1 because test tube 1 lacks food and vitamins necessary for respiration.

or

Test tube 1 would not produce ATP because food and vitamins are lacking.

Test tube 3 would produce more ATP than test tube 2 because test tube 2 lacks oxygen and vitamins necessary for aerobic respiration.

or

Test tube 3 would produce more ATP than test tube 2 because only anaerobic respiration would occur in test tube 2.

Test tube 3 would produce more ATP than test tube 4 because test tube 4 lacks oxygen necessary for aerobic respiration.

or

Test tube 3 would produce more ATP than test tube 4 because only anaerobic respiration would occur in test tube 4.



## SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS

Use the following chart to answer question 3.

Some Physiological Effects Caused by Autonomic Nervous System Stimulation						
Subject	Adrenal Glands	Thyroid Gland	Peristalsis of Digestive Tract	Pupils of the Eyes	Bronchioles	Heart Rate (beats/min)
1	–	–	+	–	–	70
2	+	+	+	+	+	90
3	+	+	–	–	–	95
4	–	+	–	–	–	75
+ indicates relatively active – indicates relatively inactive				+ indicates dilated – indicates constricted		

(6 marks)

3. a. Based on your knowledge of the effects of the autonomic nervous system, which of the above subjects appears to be the most relaxed?

*1 mark* - Subject 1

- b. Support your choice by explaining how the activity level indicated in five of the six columns in the chart suggests a relaxed state.

*Award 1 mark each for any five of the following:*

- The output of adrenaline is low when a person is relaxed, thus maintaining resting levels of heart rate and blood glucose, etc.
- Low thyroxine levels indicate low metabolic activity (low rate of cellular respiration).
- An increase in peristalsis occurs in a relaxed state; therefore, the process of digestion is enhanced.
- Heart rate is relatively low during a relaxed state since oxygen and nutrient demand is minimal.
- Pupils are constricted in a relaxed state since the need for gathering heightened amounts of visual information is not required.
- Bronchioles are constricted in a relaxed state since the demand for gas exchange is minimal.



## SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS

Total: 10 marks

*Use the following summary of a research project to answer question 4.*

The free walls of the left and right ventricles\* of young pig hearts thicken at a different rate. Researchers wanted to know why.

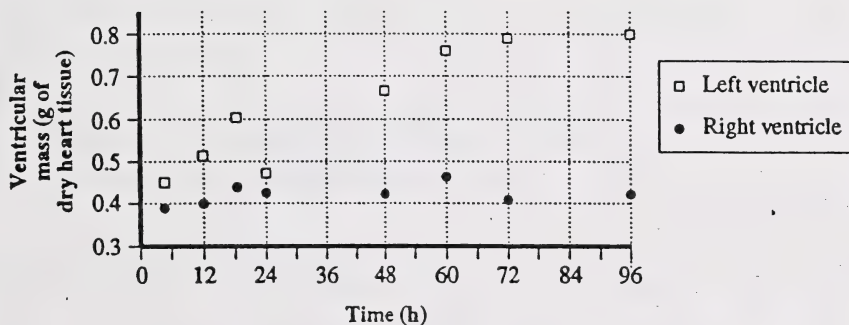
In 1990, at Pennsylvania State University, researchers examined the heart tissue of 152 pigs. Their examinations revealed a greater mass of tissue and RNA (ribonucleic acid) in the left ventricle than in the right ventricle. The researchers hypothesized that this was due to faster ribosome formation in the left ventricle.

To test this hypothesis, researchers designed a procedure to determine the relationship between rates of ribosome formation and the mass of the ventricles at different times soon after birth.

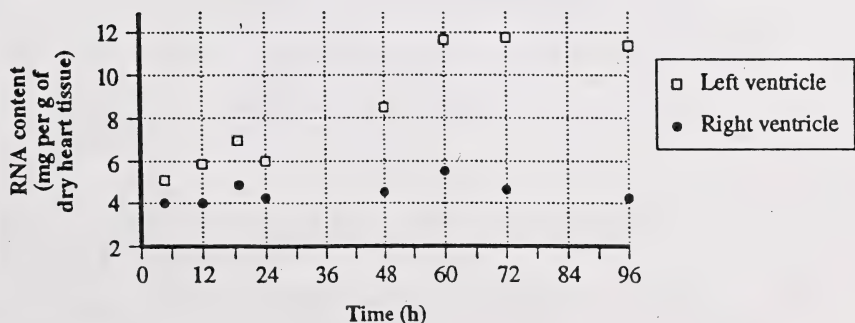
The rate of ribosome formation was determined by measuring the amount of RNA present in the ventricles. Since approximately 85% of RNA is ribosomal RNA, which is used to construct ribosomes, RNA content is proportional to ribosome content.

The rate of ventricular growth was determined by measuring the mass of tissue present in each heart ventricle. Graphs 1 and 2 show the average results of a series of measurements.

Graph 1: Mass of Heart Ventricles



Graph 2: RNA Content of Heart Ventricles



\*In their comparison of the free walls of the ventricles, the researchers did not include the septum, the wall separating the ventricles.

*Continued*



**SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS**

4. a. What specific relationship were the researchers attempting to determine? (1 mark)
- 1 mark* - The researchers were attempting to determine the relationship between the rate of ribosome formation and protein synthesis in ventricular walls.
- b. Using the line of best fit for each set of data on **graph 1** and **graph 2**, determine the initial difference (at birth) in the mass of tissue in the right ventricle and the left ventricle, and the initial difference in RNA content in the right ventricle and the left ventricle. (2 marks)
- 1 mark* - There was a difference of 0 to 0.05 g (accept any number within this range) in the masses of the right and left ventricles.
- 1 mark* - There was a difference of 0 to 0.5 mg (accept any number within this range) of RNA per g of heart tissue.
- c. Comparing the data in **graphs 1** and **2**, what generalization could be made to account for the difference in growth rates in the right ventricle and the left ventricle? (1 mark)
- 1 mark* - The left ventricle contained more RNA than the right ventricle; therefore, the left ventricle increased its tissue mass more quickly than the right ventricle.
- d. Some of the recorded points on **graphs 1** and **2** were obtained by averaging heart tissue measurements taken from as few as two young pig hearts. (1 mark)
- Using **graph 1**, examine the plotted point representing left ventricle mass at 24 h. Explain how and why the position of this point on the graph might change if data from a larger number of pig hearts were used.
- 1 mark* - This point on the graph would likely move upward if data from a larger number of pigs were used. The larger sample size might produce results more closely related to the mean, as indicated by the slope of a "line of best fit" for this graph (i.e. less chance of a departure from the mean).
- e. What ribosome function would contribute to the increase in the mass of tissue found in ventricular walls? (1 mark)
- 1 mark* - Protein synthesis would contribute to the increase in mass.

*Continued*



## SAMPLE ANSWERS TO THE WRITTEN-RESPONSE QUESTIONS

(2 marks)

- f. The researchers fed the pigs soluble organic nutrients that could readily be absorbed by body tissues. Identify one specific organic nutrient (food) that the researchers must have provided to ensure the proper development of heart tissue. Explain the importance of this nutrient.

*The student's response must indicate a soluble organic nutrient (food) that would contribute to the process of protein synthesis.*

*Award 2 marks for any one of the following possible answers. (One mark for identifying the soluble organic nutrient and one mark for explaining its importance.)*

- Amino acids are components of proteins in heart muscle.
- Nucleic acids are necessary to synthesize RNA, which is used to make ribosomes.
- Amino acids are components of proteins that are used to manufacture ribosomes.
- Glucose or simple sugars or fatty acids or glycerol or amino acids is/are needed to supply energy for the process of protein synthesis.
- Vitamins act as cofactors in cellular respiration that would supply energy for synthesis.

(1 mark)

- g. Before birth, the right and left side of a pig's heart are connected by two openings. At birth, these openings close and the ventricles begin to develop differences in the thickness of their walls. Suggest one internal stimulus that might initiate responses in heart tissue that cause the left ventricle to develop a thicker wall than the right ventricle.

*1 mark - Possible stimuli include the following:*

- Increased work load
- Reduced oxygen content in the blood
- Increased carbon dioxide content in the blood
- Presence of hormones
- Increase in aortic blood pressure or intraventricular blood pressure
- Stretching of ventricular walls
- Activation of specific genes in the nuclei of heart muscle cells

(1 mark)

- h. Suggest one reason why the researchers chose to use very young pigs as the subjects of their investigations.

*1 mark - Possible reasons include:*

- The left and right ventricles of new-born pigs are similar in thickness but develop rapidly after birth. This change would not be as noticeable in older pigs.
- Young pigs are plentiful or inexpensive or take up little space or easy to care for or larger and easier to work on surgically than some other lab animals.
- Pigs are physiologically or structurally similar to humans.
- Ethically, it is better to experiment on pigs than on humans.





# Biology 30

## January 1993

Name

Apply Label With Student's Name

Biology 30

(Last Name)

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